REMARKS

Claims 1-31, 89-92, 95, and 100-116 are now pending. In the Office action dated June 30, 2005, claims 1, 2, 13-18, 22-26, 89, 91, and 95 were rejected, and claims 2-12, 19-21, 27-31, 89, 90, and 92 were objected to. New claims 100-116 have been added. Further examination and reconsideration respectfully are requested.

Examiner's Consideration of Applicants' Information Disclosure Statement

The examiner's acknowledgement of the Information Disclosure Statement filed on July 1, 2003, is noted with appreciation.

Examiner's Acceptance of the Drawings

The examiner's acceptance of the drawings filed on July 1, 2003, is noted with appreciation.

Examiner's Acknowledge of the Priority Documents

The examiner's acknowledgement of receipt of the priority documents is noted with appreciation.

Explanation of the Amendments

The Specification has been amended as required by the examiner.

Having been withdrawn from consideration, claims 41-88 and 96-99 have been canceled without prejudice to their being reintroduced in one or more continuing applications.

Independent claims 1 and 89 have been amended by the addition of certain language pertaining to the first n-doped layer and the first p-doped layer substantially lying within an absorption depth from the groove. The absorption depth is stated as being a function of the band gap of the material in the layers, and of the wavelength of the light. This language is fully supported by the application as filed; *see, e.g.*, US 2005/0001332, ¶¶ [0035], [0036] and [0050].

Claim 2 has been amended as suggested by the examiner to correct a minor oversight in applicant's use of the term "second electrode layer." The scope of the claim has not been altered by this change.

Claim 89 has further been amended as suggested by the examiner to correct a minor typographical error in the spelling of the term "groove." The scope of the claim has not been altered by this change.

Independent Claims 1 and 89 as Amended are Patentable Over Konishi et al.

Independent claims 1 and 89 among other claims were rejected under 35 USC § 102 as anticipated by US Patent No. 4,216,487 issued to Konishi et al. As amended, claims 1 and 89 are patentable over Konishi et al.

The devices disclosed in Konishi et al. rely on the principle of optical triggering, with activation being limited to the vicinity of the blocking junction. In fact, the triggering principle used in Konishi et al. is mentioned by the applicants in the Background section of the present application, in paragraph [0005]. In contrast, the device as recited in amended claims 1 and 89 rely on the principle of direct generation of carrier pairs within the device; *see, e.g.*, US 2005/0001332, ¶¶ [0032] and [0050]. This novel aspect of the devices of claims 1 and 89 is captured in the new language added to the amended claims.

Consider Konishi et al. in more detail. Konishi et al. teaches optical activation specifically in the vicinity of the blocking junction near the groove sidewall, with no

teaching or suggestion whatsoever of optical activation throughout any of the device layers. Even the various types of light sources disclosed in Konishi et al. generally do not generate wavelengths suitable for achieving a significant absorption depth. The part of the Detailed Description from column 6, line 60 through column 7, line 44 is particularly instructive. While that part of the Detailed Description refers to Fig. 2, applicants include Figs. A-C which are based on Fig. 2 of Konishi et al. but which have been simplified in non-relevant respects and supplemented in relevant respects to improve ease of understanding.

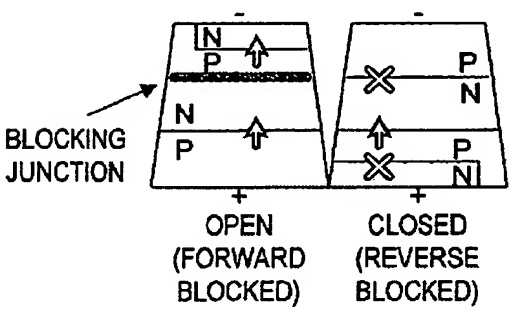

FIG. A

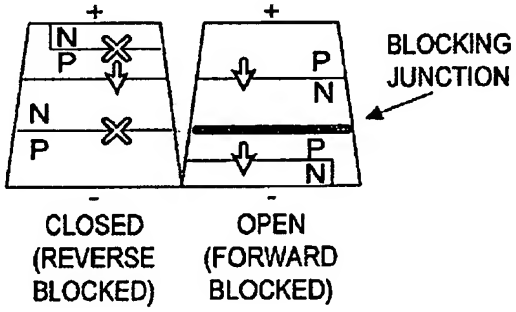

FIG. B

Since Konishi et al. does not use the term "blocking junction," Figs. A and B may be helpful to identify a blocking junction in the Fig. 2 embodiment of Konishi et al. With reference first to the present application, the term "blocking junction" is identified in Paragraph 42 as follows: "The main blocking junction 203 is the junction that blocks the flow of current when the switch 200 is in the open, or forward blocking, condition." The corresponding disclosure of Konishi et al. appears in column 6, line 60 through column 7, line 5 and column 7, lines 35-44, from which the location of blocking junctions for each switch may be identified. It will be appreciated that a blocking junction is defined for the left side switch when negative voltage is applied at the top and positive voltage is applied at the bottom, as shown by the heavily shaded junction in Fig. A; and another is defined

for the right side switch when positive voltage is applied at the top and negative voltage is applied at the bottom, as shown by the heavily shaded junction in Fig. B.

Figs. C1-C4 are included to help explain the firing mechanism of the device of Konishi et al., which is disclosed in column 7, lines 6-34. The firing mechanism occurs in several steps, which Konishi et al. explains with reference to the left side switch but which Figs. C1-C4 shows with reference to the right side switch to facilitate comparison with applicants' Fig. 2.

(STEP 1) As stated in Konishi et al. column 7, lines 6-8, triggering begins when "[r]adiation of light generates electron-hole pairs ***at and in the vicinity of the part of the second PN junction J.sub.12 exposed to the groove 8.***" (emphasis supplied).

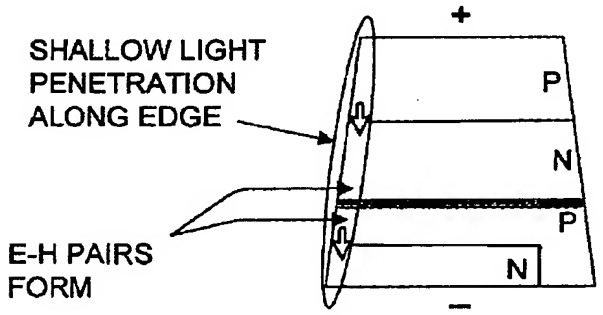

FIG. C-1
(JUNCTIONS SLIGHTLY FORWARD-BIASED AS TRIGGERING BEGINS)

In other words and as shown in Fig. C-1, light penetrates only a short distance into the device so as to generate electron-hole pairs at and in the vicinity of the part of the blocking junction exposed to the groove. Note that the other junctions of the device are only weakly forward-biased at this time, as indicated by the small arrows.

(STEP 2) As stated in Konishi et al. at column 7, lines 8-11, "***The electrons and holes are collected*** by the N.sub.B1 and P.sub.B1 layers respectively, ***thus deeply forward biasing the first PN junction*** J.sub.11 which has thus far been slightly forward biased." (emphasis supplied).

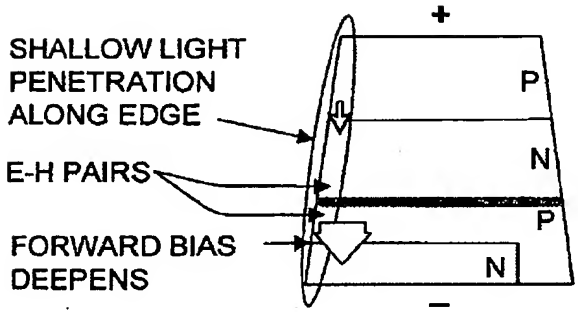

FIG. C-2
(CATHODE-SIDE JUNCTION BECOMES MORE DEEPLY FORWARD-BIASED)

In other words and as shown in Fig. C-2, the junction nearest the cathode becomes deeply forward-biased, as indicated by the large arrow. Collection of the electrons and holes is done ***through lateral current spreading***, which is similar to the mechanism of conventional electrical thyristors and is a relatively slow mechanism. The junction nearest the anode remains only weakly forward-biased, as indicated by the small arrow.

(STEP 3) As stated in Konishi et al. at column 7, lines 11-20, "When the voltage applied across the first PN junction J.sub.11 ***at its end portion adjacent to the groove 8*** exceeds the built-in potential of the first PN junction J.sub.11, electrons begin to be injected at that portion from the N.sub.E1 layer to the P.sub.B1 layer. The electrons injected into the P.sub.B1 layer are diffused into the N.sub.B1 layer through the second PN junction J.sub.12. These electrons cause the third PN junction J.sub.13 so far slightly forward biased to be deeply forward biased, ..."

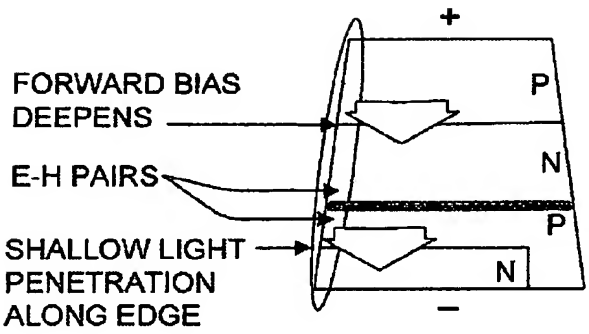

FIG. C-3
(ANODE-SIDE JUNCTION BECOMES MORE DEEPLY FORWARD-BIASED)

In other words and as shown in Fig. C-3, the junction nearest the anode now also becomes deeply forward-biased, as indicated by the large arrow, ***as the result of lateral current spreading.***

(STEP 4) As stated in Konishi et al. at column 7, lines 20-28, "when the voltage applied to the PN junction J.sub.13 exceeds the built-in potential of the third PN junction J.sub.13, holes are injected from the P.sub.E1 layer into the N.sub.B1 layer. The holes thus injected are diffused into the P.sub.B1 layer through the second PN junction J.sub.12 thereby to forward bias the first PN junction J.sub.11 more deeply. As a result, injection of electrons from the N.sub.E1 layer is promoted" (emphasis supplied).

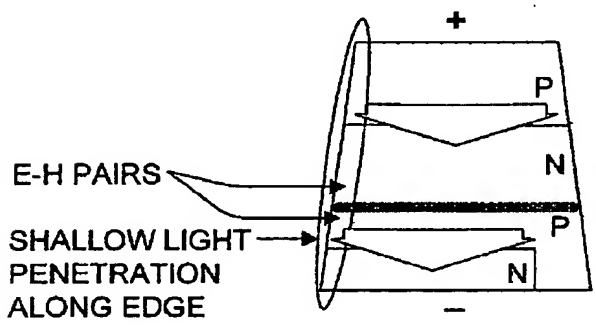

FIG. C-4
(DEVICE TURNS FULLY ON)

In other words and as shown in Fig. C-4, both junctions eventually become very deeply forward-biased, so that the thyristor fully turns on in due course. Disadvantageously, a relatively long time is required for this to happen. Like the conventional electrical firing thyristor, the optical triggering

technique of Konishi et al. relies on lateral spreading in the active turn-on process and so is slow.

In contrast to Konishi et al., the optical activation technique described in the present application uses in situ creation of carriers. As shown in Fig. D, light deeply penetrates into the device so that carrier pairs form in situ. in situ creation of carriers is fundamentally different than the Konishi et al. firing mechanism because there is no reliance on meaningful lateral spreading velocity to turn on the entire device, *see, e.g.*, US 2005/0001332, ¶¶ [0049] and [0050]. The in situ creation of carriers is made possible by having the first n-doped layer and the first p-doped layer lie substantially within an absorption depth from the groove, as claimed in amended claims 1 and 89.

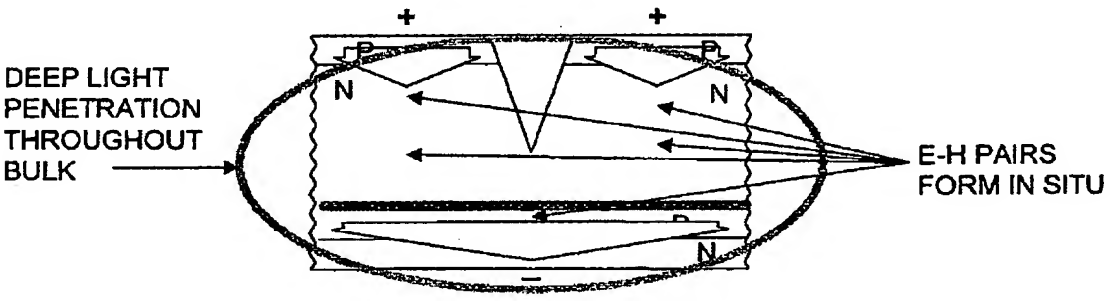

FIG. D
(DEVICE TURNS ON QUICKLY DUE TO IN SITU E-H ACTIVATION)

Rejected Dependent Claims are Patentable

The rejected dependent claims 2, 13-18, 22-26 and 91 are patentable over Konishi et al. for the same reasons as the amended independent claims from which they depend. Moreover, many of the independent claims may contain additional limitations that are not found in the combination, either expressly or inherently described, which may be additional reasons why the dependent claims are not obvious over the combination. Claim 26, for example, recites a groove having a first sloped wall forming a

first angle with the switch axis, and a second sloped wall forming a second angle with the switch axis, the first and second angles being of different slope. This differs from Figure 14 of Konishi et al, in which the slope magnitude of the sidewalls of the slot 8' and of the slot 8" are the same. Hence, claim 26 is not anticipated by Konishi et al.

The Addition of New Claims Is Proper

New claims 100-116 have been added pursuant to applicants' right to present the claimed subject matter in a reasonable number of claims of varying scope, and are believed to be within the group as defined by the examiner. The new claims are fully supported by the present application as filed and contain no new matter. Entry and examination respectfully are requested.

Conclusion

In view of the foregoing amendments, it is believed that the application is now in condition for allowance. Applicants respectfully request favorable reconsideration and the timely issuance of a Notice of Allowance. If a telephone conference would be helpful in resolving any issues concerning this communication, please contact the undersigned at (952) 253-4135.

Respectfully submitted,

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